

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 24 JAN 2006

WIPO

PCT

Applicant's or agent's file reference f-12799/pct-ms	FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/IL2004/000740	International filing date (day/month/year) 11.08.2004	Priority date (day/month/year) 02.10.2003	
International Patent Classification (IPC) or national classification and IPC H04N5/33, H04N3/15, H04N5/235			
Applicant OPGAL LTD.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 8 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 27.04.2005		Date of completion of this report 20.01.2006	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Montanari, M Telephone No. +49 89 2399-2602	



INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IL2004/000740

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-21

as originally filed

Claims, Numbers

1-64

as amended (together with any statement) under Art. 19 PCT

Drawings, Sheets

1/9-9/9

as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IL2004/000740

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-64
	No: Claims	
Inventive step (IS)	Yes: Claims	14-23,32,40,41,55
	No: Claims	1-13,24-31,33-39,42-57,60-64
Industrial applicability (IA)	Yes: Claims	1-64
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

1. Reference is made to the following documents:

D1: WO-A-03/067874

D2: EP-A-0776124

D3: WO-A-01/38825

2. Independent claims

2.1 In **claim 1**, the expression "for adjusting between a field of view and a grouping of sensing pixels to derive a required image sensitivity" is considered to be unclear, because the relation between field of view and sensitivity is not apparent, and therefore the reader is in doubt as to which FOV adjustment must be made to derive a given sensitivity (Article 6 PCT).

2.2 Documents D1 and D2 disclose that pixel grouping affects sensitivity of a sensor array. In particular, both D1 and D2 mention pixel grouping directly in combination with sensitivity (see the passages cited in the International Search Report). To adjust pixel grouping to obtain a given sensitivity, and therefore to provide a "sensitivity adjuster" as claimed, is therefore considered to lie within the capabilities of the skilled person aware of the disclosure of these documents.
Further, the sensor mentioned by D1 is an IR sensor; D2 deals with x-ray imagers, but the application of its disclosure to IR sensors is clear from the more general wording of claim 1 and from the opening paragraphs, where also IR is mentioned (page 1, lines 25-34).

For these reasons **claims 1, 49 and 64** are not considered to satisfy the criterion set forth in Article 33(3) PCT (lack of inventive step).

2.3 Although in the above opinion the unclear feature mentioned at point 2.1 has not been taken into account, it is noted that document D3 discloses a relationship giving the frame rate as a function of windowing and pixel grouping (page 40, line 18 to page 41, line 14 and figure 24) . In so far as the present application's "sensitivity adjuster" uses a change of FOV to set a given frame rate (thus obtaining a

corresponding exposure time and consequently sensitivity), the content of D3 appears to be very relevant, to the extent that this document could be considered as the closest prior art at a later stage of the procedure.

- 2.4 As to **claim 63**, document D3 discloses an image sensor having multi-resolution windowing circuitry (see e.g. page 4, line 19 to page 5, line 5), thus a sensor having the capability of adjusting FOV and pixel grouping to provide a predetermined resolution within a given region of interest. Although this document does not appear to relate to IR sensors, the application of its disclosure to IR sensors is considered to be within the capabilities of the skilled person, taking into account the content of the opening paragraphs, where tasks typically performed by IR sensors are mentioned (see e.g. page 2, line 14-17).

Thus this claim is not considered to satisfy the criterion set forth in Article 33(3) PCT (lack of inventive step).

3. **Dependent claims**

- 3.1 Although relating to an IR camera and not to an IR sensor, **claim 35** is considered to be a dependent claim because it includes the subject-matter of claim 1 (Rule 6.4 PCT).

Since the IR sensor is to be coupled to a video processor to form a video image, the feature added to claim 1 in claim 35 is considered to be obvious.

Therefore the objections raised to claim 1 apply to claim 35 as well (Articles 6 and 33(3) PCT).

- 3.2 As to **claims 8, 38 and 55**, the capability of selecting a window in a matrix sensor is known, and its use in the sensor claimed in claim 1 does not appear to cause unexpected effects or advantages - at least none easily derivable from the claimed subject-matter. Further, the use of multiresolution windows is known from D3 (see the cited passages). Thus it is not apparent that this feature, added to the subject-matter of claim 1, overcomes the objection raised above to the corresponding independent claims.

- 3.3 The feature set out in **claim 14** although not entirely clear appears to relate to the control of pixel grouping to adjust sensitivity in an exposure controlling feedback loop. If so, this feature is not disclosed by any available document and is not considered to be obvious to the skilled person, since normally such AGC-like feedback loops act on gain, exposure time or optical devices (stop values). Thus, although the provision of a user control of sensitivity by means of charge binning is considered not to involve an inventive step, the use of such a control within a feedback loop managed by a processor as claimed in claim 14 is considered to meet the criterion set forth in Article 33(3) PCT.
- 3.4 **Claim 15** corresponds to claim 14 and does not appear to introduce any new additional feature. It is suggested to delete it because superfluous. Claim 14 could be made dependent on claims 1 and 7 if the applicants so wish.
- 3.5 The additional features set out in the **remaining claims** dependent on claim 1 and not dependent on claim 14 appear to be minor implementation details either known from the cited documents D1 and D2 or which may be considered to lie within the capabilities of the skilled person.
Therefore said claims do not appear to add anything inventive to the subject-matter of claim 1.
- 3.6 Analogous comments apply, *mutatis mutandis*, to the corresponding claims dependent on other independent claims.
4. The claims are not drafted in the proper two-part form (Rule 6.3(b) PCT) thereby respecting the cited prior art in the precharacterizing portion.
5. Reference signs in parentheses should be inserted in the claims to increase their intelligibility, Rule 6.2(b) PCT.
6. To meet the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents **D1 to D3** should be mentioned in the description, and these documents identified therein.

WHAT IS CLAIMED IS:

1. An infrared sensor comprising:
a sensor array comprising multiple IR sensors, for collecting IR energy from an external scene; and
a sensitivity adjuster associated with said sensor array, for adjusting between a field of view, and a grouping of sensing pixels to derive a required image sensitivity.
2. An IR sensor in accordance with claim 1, wherein said sensor array comprises a two dimensional arrangement of said IR sensors.
3. An IR sensor in accordance with claim 1, wherein said sensor array comprises an array of photon detectors.
4. An IR sensor in accordance with claim 3, wherein said photon detectors comprise photoconductive sensors.
5. An IR sensor in accordance with claim 3, wherein said photon detectors comprise photovoltaic sensors.
6. An IR sensor in accordance with claim 1, wherein said sensor array comprises an infrared focal plane assembly (IRFPA).
7. An IR sensor in accordance with claim 1, further comprising a readout element associated with said sensor array, for performing periodic sensor array readout.
8. An IR sensor in accordance with claim 1, wherein said sensitivity adjuster comprises a window selector for selecting a readout window within said array.
9. An IR sensor in accordance with claim 1, wherein said sensitivity adjuster comprises a grouping factor selector for selecting a pixel grouping factor during IR energy collection.

AMENDED SHEET (ARTICLE 19)

10. An IR sensor in accordance with claim 7, said readout element having a readout time variable with a size of a selected readout window.
11. An IR sensor in accordance with claim 7, wherein said readout element comprises an integrate while read (IWR) device.
12. An IR sensor in accordance with claim 7, wherein said readout element comprises an integrate then read (ITR) device.
13. An IR sensor in accordance with claim 1, wherein said adjusting is in accordance with externally provided control information.
14. An IR sensor in accordance with claim 1, further comprising an image processor, for processing a sensor array output signal so as to form a feedback signal for controlling said adjusting.
15. An IR sensor in accordance with claim 7, further comprising an image processor, for processing a readout signal so as to form a feedback signal for controlling said adjusting.
16. An IR sensor in accordance with claim 14, wherein said image processor further comprises an SNR detector for detecting an SNR of said image signal.
17. An IR sensor in accordance with claim 16, wherein said detected SNR comprises an average SNR.
18. An IR sensor in accordance with claim 16, wherein said detected SNR comprises a maximum SNR.
19. An IR sensor in accordance with claim 16, wherein said detected SNR comprises a minimum SNR.

AMENDED SHEET (ARTICLE 12)

20. An IR sensor in accordance with claim 14, wherein said image processor further comprises a contrast detector, for detecting a contrast level of said image signal.
21. An IR sensor in accordance with claim 20, wherein said contrast level comprises an average contrast level.
22. An IR sensor in accordance with claim 20, wherein said contrast level comprises a maximum contrast level.
23. An IR sensor in accordance with claim 20, wherein said contrast level comprises a minimum contrast level.
24. An IR sensor in accordance with claim 1, further comprising an exposure time calculator for selecting a sensor exposure time.
25. An IR sensor in accordance with claim 24, wherein said selecting is in accordance with external scene total radiation.
26. An IR sensor in accordance with claim 24, wherein said exposure time calculator is operable to maintain an average collected charge of said sensor at a specified level.
27. An IR sensor in accordance with claim 24, wherein said selecting is in accordance with previously obtained sensor exposure levels.
28. An IR sensor in accordance with claim 7, further comprising an averager for averaging respective IR sensor levels over multiple readout cycles.
29. An IR sensor in accordance with claim 28, wherein a number of said averaged cycles comprises a maximum integer number of sensor exposure and readout cycles included in a single video frame time.

AMENDED SHEET PCT/IL0400740

30. An IR sensor in accordance with claim 1, further comprising an optical portion for focusing external IR radiation upon said sensor array.

31. An IR sensor in accordance with claim 1, said sensitivity adjuster comprises a mode selector for switching between a high-sensitivity operating mode and a low-sensitivity operating mode.

32. An IR sensor in accordance with claim 14, further comprising a mode selector for switching between a high-sensitivity operating mode and a low-sensitivity operating mode in accordance with said feedback signal.

33. An IR sensor in accordance with claim 8, further comprising a mode selector for switching between a small readout region and a large readout region, respectively to provide high-sensitivity and low-sensitivity imaging.

34. An IR sensor in accordance with claim 9, further comprising a mode selector for switching between a large pixel grouping and a small pixel grouping, respectively to provide high-sensitivity and low-sensitivity imaging.

35. An IR camera comprising:
a sensor array comprising multiple IR sensors, for collecting IR energy from an external scene;
a sensitivity adjuster associated with said sensor array, for adjusting between a field of view, and a grouping of sensing pixels to derive a required image sensitivity.
and
a video processor, for processing a sensor array output to form a video image.

36. An IR camera comprising according to claim 35, further comprising an optical portion for focusing external IR radiation upon said sensor array.

37. An IR camera comprising according to claim 35, further comprising a readout element associated with said sensor array, for performing periodic sensor array readout.

AMENDED SHEET (ARTICLE 19)

38. An IR camera comprising according to claim 35, wherein said sensitivity adjuster comprises a window selector for selecting a readout window within said array.
39. An IR camera comprising according to claim 35, wherein said sensitivity adjuster comprises a grouping factor selector for selecting a pixel grouping factor during IR energy collection.
40. An IR camera comprising according to claim 35, further comprising an image processor for processing said image signal so as to form a feedback signal for controlling said adjusting.
41. An IR camera comprising according to claim 40, wherein said feedback signal comprises at least one of: average image SNR, maximum image SNR, minimum image SNR, average image contrast, maximum image contrast, and minimum image contrast.
42. An IR camera comprising according to claim 35, further comprising a mode selector for switching between a high-sensitivity operating mode and a low-sensitivity operating mode.
43. An IR camera comprising according to claim 35, wherein said IR camera comprises a FLIR device.
44. An IR camera according to claim 35, further comprising an image analyzer, for analyzing said video image to identify specified properties of interest.
45. An IR camera according to claim 44, wherein said IR camera comprises a surveillance device.
46. An IR camera according to claim 44, wherein said IR camera comprises a targeting device.

AMENDED SHEET (ARTICLE 19)

47. An IR camera according to claim 35, further comprising a head up display (HUD).

48. An IR camera according to claim 47, wherein said IR camera comprises an aircraft visibility enhancer.

49. A method for IR sensing, comprising:
adjusting a pixel grouping of a sensor array to provide a required image sensitivity;
and
collecting IR energy over a variable window fromn external scene with said sensor array in accordance with said pixel grouping.

50. A method in accordance with claim 49, further comprising selecting a sensor exposure time.

51. A method in accordance with claim 50, wherein said selecting is to maintain an average collected charge of said sensor at a specified level.

52. A method in accordance with claim 50, wherein said method is performed repetitively at a maximum rate permitted by said pixel grouping and said selected exposure time.

53. A method in accordance with claim 50, wherein said selecting is in accordance with previously obtained sensor exposure levels.

54. A method in accordance with claim 49, further comprising performing periodic sensor readout.

55. A method in accordance with claim 49, wherein said adjusting comprises selecting a readout window within said array.

AMENDED SHEET (ARTICLE 19)

56. A method in accordance with claim 49, wherein said adjusting comprises a selecting a grouping factor.
57. A method in accordance with claim 55, wherein said adjusting comprises a selecting a grouping factor.
58. A method in accordance with claim 54, further comprising forming a feedback signal for controlling said adjusting from said sensor readout.
59. A method in accordance with claim 58, wherein said feedback signal comprises at least one of: average image SNR, maximum image SNR, minimum image SNR, average image contrast, maximum image contrast, and minimum image contrast.
60. A method in accordance with claim 54, further comprising averaging respective sensor levels over multiple readout cycles.
61. A method in accordance with claim 49, further comprising switching between a high-sensitivity operating mode and a low-sensitivity operating mode.
62. A method in accordance with claim 49, further comprising analyzing a video IR image to identify specified properties of interest.
63. An infrared sensor comprising:
a sensor array comprising multiple IR sensors, for collecting IR energy from an external scene; and
a field of view adjuster associated with said sensor array, for adjusting between a field of view and a grouping of sensing pixels to provide a required spatial resolution.
64. An infrared (IR) sensor, comprising:
a cryogenically cooled sensor array comprising multiple IR sensors, for collecting IR energy from an external scene; and

AMENDED SHEET (ARTICLE 19)

a sensitivity adjuster associated with said sensor array, for adjusting a pixel grouping to provide a required image sensitivity.

AMENDED SHEET